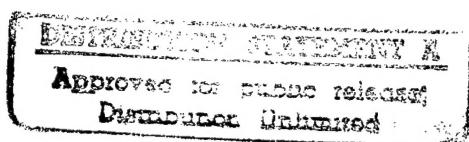


JPRS-UEE-90-009  
8 AUGUST 1990



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# ***JPRS Report***



# **Science & Technology**

## ***USSR: Electronics & Electrical Engineering***

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# Science & Technology

## USSR: Electronics & Electrical Engineering

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### CONTENTS

08 August 1990

#### Broadcasting, Consumer Electronics

Use of MIS-LC Structures and Luminance Amplifiers for Projection of Television Images on Large Screen [Yu. M. Gusev, Yu. D. Dumarevskiy, et al.; <i>TEKHNICA KINO I TELEVIDENIYA</i> , No 9, Sep 89]	1
Enhancing the Utility of Optical Cables in Municipal Telephone Networks [V. N. Korshunov; <i>VESTNIK SVYAZI</i> , No 9 Sep 89]	1
Improvements in the Reliability of Digital Technology [G. S. Kobosov, V. N. Kovylev, et al.; <i>VESTNIK SVYAZI</i> , No 9 Sep 89]	1
The "Vyaz-M2" Transmitter for Radio Broadcasting [G. I. Fridman; <i>VESTNIK SVYAZI</i> , No 9, Sep 89]	1
Mobile Radio Communications on the Oblast Level [N. P. Fomenko, L. R. Shanina; <i>VESTNIK SVYAZI</i> , No 9, Sep 89]	2
The KT857A, KT858A, and KT859A High-Voltage Power Transistors [M. Viktorov; <i>VESTNIK SVYAZI</i> , No 9, Sep 89]	2
The Features of Low Level Signal Transmission by Optical Sound Recording [L. I. Zhuravleva; <i>TEKHNICA KINO I TELEVIDENIYA</i> , No 8, Aug 89]	2
Optical Address Graphics Display [N. A. Filinyuk, V. V. Motygin, et al.; <i>TEKHNICA KINO I TELEVIDENIYA</i> , No 8, Aug 89]	2
System for Digital Transmission of Television Signals on Fiber-Optic Trunks [S. S. Kogan, L. Kh. Nurmukhamedov, et al.; <i>TEKHNICA KINO I TELEVIDENIYA</i> , No 8, Aug 89]	3
Cost Efficiency Analysis of Satellite Communications Networks [G. B. Askinazi, O. A. Tulubeva; <i>ELEKTROSVYAZ</i> , No 9, Sep 89]	3
Effect of Signal Delay on Synchronization Error [V. M. Barkov; <i>ELEKTROSVYAZ</i> , No 9, Sep 89]	3
Digital Message Transmission by Means of Frequency-Adaptation Multichannel Modems [Ye. F. Shcheglova; <i>ELEKTROSVYAZ</i> , No 9, Sep 89]	3
The Possibilities for Enhancing Fresnel Disk Lenses [V. Dybchinski; <i>TEKHNICA KINO I TELEVIDENIYA</i> , No 12, Dec 89]	3
Satellite Television: One Element in a Comprehensive Program [A. Barsukov; <i>TEKHNICA KINO I TELEVIDENIYA</i> , No 12, Dec 89]	4
A Method of Enhancing Picture Sharpness in a Prefiltering System [O. I. Krasilnikova; <i>TEKHNICA KINO I TELEVIDENIYA</i> , No 12, Dec 89]	4
Noncoherent Reflection of Electromagnetic Waves by Semibounded Plasma [A.G. Zagorodniy, A.S. Usenko, et al.; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA</i> , Vol 32, No 9, Sep 89]	4
Real-Time Bilateral Signal Transformation [Z. D. Lerner; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE</i> , No 8, Aug 89]	4
Sequential Interframe Multiple State Measurement Identification for Application to Dynamic Objects [A. V. Ekalo; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE</i> , No 8, Aug 89]	5
Multisize Component Distribution Subsystem in a Computer-Aided Topology Design System [O. I. Belobaba, A. L. Kuznetsov; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE</i> , No 8, Aug 89]	5
Design of an Industrial Vision System for Object Recognition Based on Follow Scanning [Ye. I. Kovrigin, V. S. Chernyshev; <i>IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE</i> , No 8, Aug 89]	5
Special Government Standard of Unit Phase Angle between Two Voltages Covering $1 \times 10^{-2}$ - $2 \times 10^7$ Hz Frequency Range [S. A. Kravchenko, A. A. Anepir, <i>IZMERITELNAYA TEKHNICA</i> , No 8, Aug 89]	5
Interference-Type Apparatus for Checking up to 200 mm Long Stroke Gages [IZMERITELNAYA TEKHNICA No 8, Aug 89]	6
Service Standard of Unit Pulsed-Laser Radiation Energy [G. L. Kabanov, S. A. Kaufman; <i>IZMERITELNAYA TEKHNICA</i> , Aug 89]	6

Dynamic Calibration of Radiometer Based on Nonisothermal Black-Body Model [K. A. Butakov, S. V. Butakova; IZMERITELNAYA TEKHNIKA, No 8, Aug 89]	6
Modern Trends in the Development of Transducer Equipment [Ye. P. Osadchiy; PRIBORY I SISTEMY UPRAVLENIYA, No 7, Jul 89]	6
Surface Acoustical Wave Transducers [V. Yu. Snitko; PRIBORY I SISTEMY UPRAVLENIYA, No 7, Jul 89]	7
Transducers Based on Heteroepitaxial Germanium Films Deposited on Gallium Arsenide [V. F. Mitin, S. V. Korytsev, et al.; PRIBORY I SISTEMY UPRAVLENIYA, No 7, Jul 89]	7
Resistive Transducers Based on Gallium Arsenide-Phosphide Single Crystals [A. S. Ostrovskaya, S. S. Varshava; PRIBORY I SISTEMY UPRAVLENIYA, No 7, Jul 89]	7
Book: Principles of Very Wide Band Radar Measurements [L. Yu. Astanin; OSNOVY SVERKSHIROKOPOLOSNYKH RADIOLOKATSIONNYKH IZMERENIY, 1989]	7
Performance Evaluation of Semiconductor Ballast Systems [Ye. G. Ovsepyants, N. N. Shkuro; SVETOTEKHNIKA, in Russian No 9, Sep 89]	10
Methods of Improving Capacitive Pressure and Acceleration Transducers [V. M. Artemov, E. A. Kudryashov, et al.; PRIBORY I SISTEMY UPRAVLENIYA, No 9, Sep 89]	10
Transverse Piezoelectric Elements for Force and Pressure Transducers [E. A. Kudryashov, V. Ye. Mager, et al.; PRIBORY I SISTEMY UPRAVLENIYA, No 9, Sep 8]	11
Thermal Resonance Transducers [E. A. Kudryashov; PRIBORY I SISTEMY UPRAVLENIYA, No 9, Sep 89]	11
Computer-Aided Start-to-Finish Mechanical Transducer Design Systems [E. M. Shmakov; PRIBORY I SISTEMY UPRAVLENIYA, No 9, Sep 89]	11
Paraphase Logic Elements as a Promising Element Base for Ultrahighspeed Digital Large-Scale Integrated Circuits [V. V. Bochkarev, I. I. Shagurin; MIKROELEKTRONIKA, in Russian Vol 18 No 9, Sep 89]	11
Modeling and Calculation of the Mechanical Stresses in Integrated Circuit Structures [A. A. Gorbatshevich, Yu. A. Parmenov, et al.; MIKROELEKTRONIKA, Vol 18 No 9, Sep 89]	12
Application of Capacitive Techniques to Monitoring Epitaxial GaAs Structures Designed for Fabrication of Integrated Circuits and Schottky-Barrier FETs [V. Ya. Prints, V. A. Samoylov; MIKROELEKTRONIKA, Vol 18 No 9, Sep 89]	12
Equipment Set for Welding Training of Splicers for Assembly of KOMS Optical Cable [VESTNIK SVYAZI, No 8, Aug 89]	12
The IKM-12U Secondary Digital Transmission System Equipment [L. S. Levin, A. M. Mekkel, et al.; ELEKTROSVYAZ, No 10, Oct 89]	13
Evaluation of the Accuracy of the Minimum Capital Expenditure Criterion for Calculating the Number of Channels on a Long-Distance Telephone Network [V. G. Dedoborsch, V. A. Ershov, et al.; ELEKTROSVYAZ, No 10, Oct 89]	13
Signal Generation Problems in a Digital Radio Broadcasting System [M. Ya. Lesman, Yu. B. Okunev, et al.; ELEKTROSVYAZ, No 10, Oct 89]	13
Determination of the Number of Shortwave Radio Broadcasting Stations Operating Simultaneously at a Common Frequency [V. G. Dotolev, G. M. Kuzkina, et al.; ELEKTROSVYAZ, No 10, Oct 89]	13
Metrologic Support of Fiber-Optic Communications Link Construction [S. M. Vernik, S. F. Glagolev, et al.; VESTNIK SVYAZI, No 10, Oct 89]	14
Improving Printed Circuit Board Quality [V. S. Demenkov, V. M. Yeskov; VESTNIK SVYAZI, No 10, Oct 89]	14
An Electronic Information Service for Municipal Telephone Networks [B. S. Goldshteyn, B. F. Zhuravskiy, et al.; VESTNIK SVYAZI, No 10, Oct 89]	14
The Development of Satellite Communications and Broadcasting Systems Based on Large-Scale Space Platforms [L. Ya. Kantor; ELEKTROSVYAZ, No 12, Dec 89]	14
The DKD-400 Multifunction Digital Satellite Communications Equip ment [V. M. Dorofeev, Yu. F. Kononov, et al.; ELEKTROSVYAZ, No 12, Dec 89]	15
Quality of Speech Transmission by Block Pulse-Code Modulation on Analog-Digital Satellite and Ground-Based Communications Channels [V. P. Kokoshkin, N. I. Marinicheva, et al.; ELEKTROSVYAZ, No 12, Dec 89]	15
Investigation of a Digital Synchronization System for a Satellite Radio Link [V. V. Shakhgildyan; ELEKTROSVYAZ, No 12, Dec 89]	15
A Data Transmission Network Based on Analog Office Automatic Telephone Exchanges [T. I. Guan, V. P. Zhavoronkov, et al.; ELEKTROSVYAZ, No 12, Dec 89]	15
Distribution of Signal Delay in Digital Switching Elements [G. P. Basharin, V. A. Naumov; ELEKTROSVYAZ, No 12, Dec 89]	16

Analysis of the Spectral Noise Characteristics of a Laser-Fiber System [P. A. Mishnaevskiy, P. P. Ovryan; <i>ELEKTROSVYAZ</i> , No 12, Dec 89]	16
The Features of Transfer Conductance and Impedance Measurements for Cylindrical Screens [V. K. Lipskiy, I. Ch. Ronchevich; <i>ELEKTROSVYAZ</i> , No 12, Dec 89]	16
"INKOMS" Communications Equipment on Exhibit in Moscow	16
Remote Control and Monitoring of a Telegraph Network [R. D. Abramov; <i>VESTNIK SVYAZI</i> , No 1, Jan 90]	17
An Elevated Throughput Capacity Message Switching Electronic Telegraph Concentrator [A. A. Kachan, M. A. Sosorev; <i>VESTNIK SVYAZI</i> , No 1, Jan 90]	17
Electronic Control for a Postal Package Bay [V. N. Dolenko; <i>VESTNIK SVYAZI</i> , No 1, Jan 90]	17
Modernization and Conversion of the Vyaz-M2-OP Transmitter [G. I. Fridman; <i>VESTNIK SVYAZI</i> , No 1, Jan 90]	17
Electrical Actions on the Static Thyristor Compensator Equipment at the Moldavian Metallurgical Factory [O. P. Nechaev, I. P. Taratuta, et al.; <i>ELEKTROTEKHNIKA</i> , No 8, Aug 89]	17
Electromagnetic Compatibility in Electrical Power Systems for Industrial Facilities [V. V. Shevchenko, I. G. Buree; <i>ELEKTROTEKHNIKA</i> , No 8, Aug 89]	18
Electromagnetic Compatibility Enhancement of Thyristor Converters of Comparable Power [V. A. Barskiy; <i>ELEKTROTEKHNIKA</i> , No 8, Aug 89]	18
New Thyristor Converters [N. V. Sklyaruk, V. I. Vasilev; <i>ELEKTROTEKHNIKA</i> , No 8, Aug 89]	18
Modeling of Magnetization Reversal in the Core of Pulsed Transformers [V. V. Karasev; <i>ELEKTROTEKHNIKA</i> , No 8, Aug 89]	18
Response Formation in Coherent Optical Processor upon Processing of Multichannel Electrical Signals [A. I. Plakhotnik; <i>OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST</i> , No 2, Feb 90]	19
Accuracy of Measurement of Slope of Optical Radiation Phase Front [V. Ye. Kirakosyants, V. A. Loginov; <i>OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST</i> , No 2, Feb 90]	19
Improvement in Metal Mirror Manufacturing Technology [Yu. V. Zaikin; <i>OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST</i> , No 2, Feb 90]	19
Confidence Intervals of Mean Square Wave Front Deformation and Contrast Transfer Function in Testing of Optical Systems [I. P. Agurok; <i>OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST</i> , No 2, Feb 90]	19
Working Ends of Fiber Light Guides [L. V. Borisyuk; <i>OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST</i> , No 2, Feb 90]	20
The ELA-60/15, ELA-50/5T and ELA-60/15T Electron-Beam Instruments [A. P. Bdulenko, S. A. Garsyukov, et al.; <i>OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST</i> , No 2, Feb 90]	20
Delayed Structural Changes in Magnetic Field-Stimulated Semiconductors [V. Davydov, Ye. A. Loskutova, et al.; <i>FIZIKA TEKHNIKA POLUPROVODNIKOV</i> , Vol 23 No 9, Sep 89]	20
Hot Electron Microwave Noise in GaAs at Crystal Temps of 10-100 K [R. D. Aitov, A. I. Moslov, et al.; <i>FIZIKA TEKHNIKA POLUPROVODNIKOV</i> , Vol 23 No 9, Sep 89]	20
Magnetic Field-Induced Electron Transitions in Semiconductors with a Superlattice [V. M. Polyanskiy; <i>FIZIKA TEKHNIKA POLUPROVODNIKOV</i> , Vol 23 No 9, Sep 89]	21



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### Use of MIS-LC Structures and Luminance Amplifiers for Projection of Television Images on Large Screen

907K0021A Moscow *TEKHNICA KINO I TELEVIDENIYA* in Russian No 9, Sep 89 pp 19-23

[Article by Yu. M. Gusev, Yu. D. Dumarevskiy, K. I. Zemskov, M. A. Kazaryan, A. B. Kasyanov, N. F. Kovtonyuk, L. V. Medvedeva, G. G. Petrash, V. N. Revenko, A. V. Sadchikhin, L. S. Telegin and A. M. Trufanov, Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences]

[Abstract] Use of liquid crystals as space-time light modulators for projection of images from the cathode-ray-tube screen onto a large screen is proposed, a nematic liquid crystal being carried by an MIS structure with GaAs as the semiconductor material. Either a powerful incandescent lamp or a laser can serve as source of high-intensity light for reading out the image from such a modulator. With an incandescent lamp it is necessary to use interference-type polarizers, which most efficiently convert phase modulation into amplitude modulation with adequately high contrast. The contrast in this case is determined by the contrast-frequency characteristic of such a modulator, which in turn depends on the divergence angle of the reading light flux. The main advantage of a laser, particularly suitable for this application being metal (Cu,Au)-vapor lasers operating in the saturation mode, is that the density of luminous power in the liquid crystal need not be high. An experiment was performed for determination of the modulator energy characteristic in the pulse recording mode, with the duration of exciting light pulses varied over the 0.05-0.19 ms above the 0.1 amplitude level and the pulse repetition period remaining 20 ms throughout. Such a modulator was also tested with a cathode-ray-tube, an at least 2-5 ms persistence of the luminophor coating on the screen surface having been found to be most desirable. A red luminophor with a persistence of 3 ms above the 0.1 maximum luminance level was accordingly applied to the cathode-ray-tube screen. With a liquid crystal as phase object between two crossed polarizers, the optimum duration of recording pulses for minimum modulator turn-on time has been established for high and low modulation factors on the basis of minimum modulator excitation energy. Figures 3; references 5: 4 Russian, 1 Western.

### Enhancing the Utility of Optical Cables in Municipal Telephone Networks

907K0025c Moscow *MIKROELEKTRONIKA* in Russian No 9 Sep 89, pp 45-48

[Article by V. N. Korshunov]

[Abstract] This study presents recommendations to improve the utility of optical cables on municipal telephone network trunks. The recommendations are based on a statistical analysis of such variable factors as the statistical frequency  $W$  of the network containing trunks of length  $L$  between the

nearest regional automatic telephone exchanges, the network nodes, the long-distance exchanges, and the capacity  $M$  of channel groups on multiplexed trunks and physical lines on unmultiplexed trunks. This frequency represents the relative fraction of trunks with given values of  $L$  and  $M$ . The article provides sample network configurations and histograms of the frequencies of occurrence of trunks of various length in the municipal telephone networks. With regard to the issue of improving optical cable utility for interexchange trunks in the networks the article focuses on selecting the transmission parameters of the cable (attenuation, bandwidth) and maintaining consistent parameters between such sections and determining the necessary number of optical fibers per cable; this factor establishes (in conjunction with the number of channels in the link utilized) the capacity of the channel group in each optical cable. This makes it possible, for a given trunk capacity, to determine the necessary number of optical cables on a given route.

### Improvements in the Reliability of Digital Technology

907K0025d Moscow *MIKROELEKTRONIKA* in Russian No 9, Sep 89, pp 48-49

[Article by G. S. Kobosov, V. N. Kovylev, V. M. Livshits]

[Abstract] Measures have been taken to improve the reliability of digital transmission systems based on analyses of statistical failure and down-time data on digital transmission systems in actual operating conditions. Down time and fault data were collected and analyzed in this study on the IKM-15, the "Zona-15" and the "Radan" digital transmission systems in both operational and production processes. The measures implemented as a result of this analysis included a 400 hour test run of several component parts in dynamic operating conditions, a reanalysis of the nomenclature and composition of the spare parts and equipment used in the IKM-15 and the "Zona-15" equipment and the development of a new spare parts and equipment set for the "Radan" system. These and other measures made it possible to substantially improve the performance of the digital transmission systems. The average time between failure of the IKM-15 equipment increased by a factor of 2.6 while this same indicator improved by a factor of 1.3 for the "Zona-15" and by a factor of 1.2 for the "Radan-2" systems.

### The "Vyaz-M2" Transmitter for Radio Broadcasting

907K0025e Moscow *MIKROELEKTRONIKA* in Russian No 9, Sep 89, pp 58-60

[Article by G. I. Fridman]

[Abstract] Proposed improvements to the "Vyaz-M2" radio transmitter are intended to reduce nonlinear dis-

tortion, expand the operational frequency band while simultaneously improving the amplitude-frequency response, reducing the noise and background levels, etc., i.e., expanding the operational dynamic range. Such improvements can be achieved by some minor modifications. In order to improve the amplitude response of the transmitter, i.e., reduce nonlinear distortion, the operating point on the modulation characteristic is dropped down in the fourth stage in order to increase the d.c. negative voltage across the screen grids of the GU-81 tubes. The audiofrequency bandpass filter is removed in order to expand the ultralow frequency audio band. The article also proposes making the negative feedback network in the transmitter a variable network in order to achieve general improvements in the amplitude frequency response and the nonlinear distortion levels. The study also notes that in order to improve the performance of the negative feedback network at the upper audio frequencies it is necessary to reduce the phase shifts in the feedback loop at these frequencies.

#### **Mobile Radio Communications on the Oblast Level**

907K0025F Moscow MIKROELEKTRONIKA  
in Russian No 9, Sep 89, pp 61-62

[Article by N. P. Fomenko, L. R. Shanina]

[Abstract] A unified system of radio communications networks developed by the Kuybyshev Industrial-Technical Communications Administration is intended for all segments of the National Economy of an oblast and is designed to account for the evolving structure, financial capabilities of the economy, as well as the capabilities of the industry manufacturing the radio communications equipment. This system consists of three operational and territorial levels: the facility-wide level, the regional center level, and the Oblast level. The first level, the facility-wide level, employs radio communications with a central base using "Len" radio sets with the subscriber radio sets installed on vehicles and temporary team facilities. Communications in this case is limited to the territory of the facility (collective farm, state farm, etc.: 10-15 km). On the second level - the regional center level - the radio network subscribers are managers and directors of Party and Soviet organs, communal, housing, and special services, agricultural managers and their dispatcher services. The third level - the Oblast level - includes subscribers who are managers and directors of Party and Soviet organs, enterprises, and organizations on the Oblast level whose activities require ongoing communications with subscribers on the second radio communications level. This system is essentially a general purpose communications system and is designed to improve communications on an Oblast-wide level.

#### **The KT857A, KT858A, and KT859A High-Voltage Power Transistors**

907K0025f Moscow MIKROELEKTRONIKA  
in Russian No 9, Sep 89, pp 69-70

[Article by M. Viktorov]

[Abstract] The specifications, performance, and design principles of the KT857A, KT858A, and KT859A high-voltage

power transistors used in general purpose switching and line equipment are reported in this article. The devices are particularly advantageous in pulsed equipment, since these transistors have low voltage drops in saturated operating conditions. The transistors are designed to operate over a temperature range of -40 to 100°C at a relative humidity of 98 percent, vibrational loads from one to 600 Hz and stresses of up to 10 G. The KT857A and KT858A devices are planar-epitaxial silicon power n-p-n transistors with a single chip design. The topology provides for four separation rings to achieve a maximum collector-to-base breakdown voltage. The KT859A can be used in secondary power supplies. The devices are manufactured using the KT28 compact plastic package and weigh less than 2.5 g.

#### **The Features of Low Level Signal Transmission by Optical Sound Recording**

907K0034a Moscow TEKHNKA KINO I  
TELEVIDENIYA in Russian No 8, Aug 89, pp 12-19

[Article by L. I. Zhuravleva]

[Abstract] This study investigates the features of medium-frequency (1 kHz) and high-frequency (8-10 kHz) low-level (3 percent or below) signal transmission by optical sound recording. A technique is also developed for calculating the relative effect of noise from light, dark, and transition areas on the optical sound track on the transmission conditions of signals at various frequencies recorded at different modulation levels. Analysis of low-level medium- and high-frequency signal transmission by 35 mm optical sound recording has demonstrated that signals below 3 percent modulation are substantially masked by granular noise on the optical sound recording track. The signal masking effect is largely dependent on the noise levels and is also dependent on the modulation transmission function of the track printing and recording process. The method proposed for calculating the modulation noise accompanying reproduction of the sound signal has identified a contribution from both the light, dark, and crossover areas on the optical sound recording which depends on the signal frequency and amplitude.

#### **Optical Address Graphics Display**

907K0034b Moscow TEKHNKA KINO I  
TELEVIDENIYA in Russian No 8, Aug 89, pp 24-26

[Article by N. A. Filinyuk, V. V. Motygin, V. I. Bilyk]

[Abstract] This study reports the results from experimental analyses of liquid crystal data recording and subsequent display on a light screen. The system consists of a liquid crystal transparency, an optical section (consisting of an He-Ne laser, a mirror, and a vertical electromechanical deflector), and a controller. Block diagrams and schematics of these elements of the system are provided. The system operation is based on the thermo-optic effect in liquid crystals and can produce on-screen lines of various thicknesses from 0.4 to 2.0 mm. This is achieved by varying the

laser beam scanning speed from 7.8 to 0.1 m/s on-screen. When the scanning speed is elevated above 7.8 m/s no information is recorded on the liquid crystal since the liquid crystal molecules are not under sufficient local thermal action to disrupt the liquid crystal geometry. The device described in this article can be used to fabricate a projection graphics display for a computer-aided design workstation.

### System for Digital Transmission of Television Signals on Fiber-Optic Trunks

907K0034c Moscow *TEKHNICA KINO I TELEVIDENIYA* in Russian No 8, Aug 89 pp 27-32

[Article by S. S. Kogan, L. Kh. Nurmukhamedov, V. M. Solovev]

[Abstract] This article analyzes a new generation of digital transmission equipment for transmitting television signals on fiber-optic trunks at transmission speeds of 139,264 bits/sec over distances of up to 30 km without intermediate repeaters. The design configuration and layout of the entire digital transmission system is considered, including the organizational layout of equipment and fiber-optic trunks, the design, performance and specifications of the digital television equipment, the digital television signal generation equipment and signal code maps, the generation of the GTsP-140 digital code and its transmission on the optical fiber and the extraction of information characters from the digital stream on the receive side, the recovery of the analog television signal and the digital audio system. Such support functions as troubleshooting, maintenance, automatic back-up and component base of the system are also discussed.

### Cost Efficiency Analysis of Satellite Communications Networks

907K0051a Moscow *ELEKTROSVYAZ* in Russian No 9, Sep 89, pp 7-10

[Article by G. B. Askinazi, O. A. Tulubeva]

[Abstract] This article develops a cost efficiency analysis algorithm used to analyze a broad variety of satellite communications networks employing various signal transmission techniques and satellite network topologies. The algorithm consists of eight steps. The satellite channels are distributed among earth stations and up-links/down-links in the first stage. The network cost - the earth station, satellite channel, and overall network costs - is calculated in the second stage. The cost efficiency of the satellite network compared to an equivalent ground network is calculated in the third stage. The network capacity is matched to the transponder capacity in the fourth stage. The fifth stage distributes channel capacity among the up-link/down-link channels. The cost efficiency of the modified network is then recalculated using the algorithm and program from the second stage. The cost efficiency of the individual up-link/down-link channels is analyzed in the seventh stage and the cost of the earth stations and the up-link/down-link channels are

again calculated using the second stage algorithm and program in the final stage. The algorithm is used to determine the advisability of using satellite communications networks for specific applications and to select the best such network and to identify network areas in which ground-based channels are best utilized.5

### Effect of Signal Delay on Synchronization Error

907K0051C Moscow *ELEKTROSVYAZ* in Russian No 9, Sep 89 pp 28-32

[Article by V. M. Barkov]

[Abstract] A previously-developed model that has been used to establish the effect of phase-locked loop circuit characteristics on the stability of a system of synchronized oscillators has been used to analyze synchronization techniques from the viewpoint of minimizing errors by accounting for delay effects. The synchronization error in this study refers to the phase difference between the synchronized oscillators. The synchronization errors derived from the study are provided in a table; the table also provides the frequency instabilities generated in the synchronized oscillators resulting from incomplete compensation of signal delays in the line and instrument errors in setting the phase of the synchronized oscillators. A simple forced synchronization method whereby signal line delay is compensated is found to provide minimum synchronization error.

### Digital Message Transmission by Means of Frequency-Adaptation Multichannel Modems

907K0051D Moscow *ELEKTROSVYAZ* in Russian No 9, Sep 89, pp 52-54

[Article by Ye. F. Shcheglova]

[Abstract] Suboptimum frequency selection algorithms have been developed for frequency group selection in frequency-adaptation digital transmission systems. The algorithms are used to carry out calculations to establish noise immunity performance of such systems and the analysis reveals that there exists a critical bandwidth above which no substantial increase in noise immunity occurs. The best suboptimum algorithm with respect to noise immunity is the algorithm producing a frequency group having a maximum signal-to-interference ratio in the worst channel (the maximin algorithm). The suboptimum frequency selection algorithms developed here are also used to plot error probabilities of the system and the curves provided in this study make it possible to select system parameters with constraints dictated by both the technical capabilities of the individual frequency segments of a frequency-adaptive system (broadband performance, frequency tuning time, etc.).

### The Possibilities for Enhancing Fresnel Disk Lenses

907K0134a Moscow *TEKHNICA KINO I TELEVIDENIYA* in Russian No 12, Dec 89 pp 15-19

[Article by V. Dybchinski]

[Abstract] Fresnel disk lenses are widely used in cinematography and television and are also employed in theat-

rical and museum lighting and in architectural illumination and "light and sound" shows. This study considers the possibilities for enhancing fresnel disk lenses by modernizing their design. Appropriate formulae were derived to calculate the relative luminous fluxes for lenses of different curvature as a function of focal length. Calculations were carried out for lenses with focal lengths from 100 to 200 mcm, an effective diameter of 230 mm, and a stepped curvature of 1.1, 1.43, and infinity. Plots of the angular width of the elementary beam as a function of the capture angle of the lens are given together with the magnification increment as a function of capture angle of various lenses with a 150 mm focal length. The analysis suggests that it is possible to enhance the luminous efficiency of such lenses by reducing the focal length and increasing their curvature.

### Satellite Television: One Element in a Comprehensive Program

907K0134b Moscow *TEKHNICA KINO I TELEVIDENIYA* in Russian No 12, Dec 89 pp 19-30

[Article by A. Barsukov]

[Abstract] This general survey of the future role of satellite networks in direct television broadcasting reviews the existing satellite networks, their service regions, sponsoring nations, and affiliated organizations, broadcasting specifications, and possible uses for television broadcasting in the respective nations. The differences in the design and operating assumptions of Intersputnik versus western satellite networks and services are discussed. The study identifies measures that must be taken to modify or design new equipment to support direct subscriber television broadcasting using existing and future spacecraft. The technical aspects of both television broadcasting and telephony such as output power, transmitting frequencies, modulation techniques, antenna directivity, permissible noise levels, geographical coverage etc, are given together with ground trace maps of service regions and the "Stationary-4" and "Stationary-13" Soviet spacecraft. The text of the "Convention on Propagation of Satellite Programming Signals" signed in Brussels on May 21, 1974 is reprinted in its entirety.

### A Method of Enhancing Picture Sharpness in a Prefiltering System

907K0134c Moscow *TEKHNICA KINO I TELEVIDENIYA* in Russian No 12, Dec 89 pp 30-32

[Article by O. I. Krasilnikova]

[Abstract] This article considers techniques for improving picture sharpness and clarity by effective two-dimensional low-frequency picture filtering by synthesized aperture filtering. In the design analyzed in this study filtering is implemented in a checkerboard configuration; the image is first sampled in the checkerboard configuration in an x, y coordinate system, is written in a digital memory while the values of the samples to be transmitted to the communications channels are then recovered by weighted summing of the primary samples

that lie along the x prime y prime axes relative to the initial coordinate system, i.e., in diagonal directions of the x, y coordinates. If the structure of the samples takes the form of a checkerboard configuration in the x, y coordinate system it is orthogonal in the x prime y prime coordinate system. This resulted in a 45° shift of the picture spectrum thereby making it possible to use the processing programs that model two-dimensional filtering and orthogonal sampling. The picture obtained using this process is given in the study. The effectiveness of this method makes it possible to recommend its application in both existing high density television and in any other picture transmission systems.

### Noncoherent Reflection of Electromagnetic Waves by Semibounded Plasma

907K0042C Gorkiy *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA* in Russian Vol 32, No 9, Sep 89 (manuscript received 29 Sep 87) pp 1097-1112

[Article by A. G. Zagorodniy, A. S. Usenko, and I. P. Yakimenko, Institute of Theoretical Physics, USSR Academy of Sciences]

UDC 533.932

[Abstract] Noncoherent reflection of plane electromagnetic waves by a half-space containing a weakly ionized plasma is analyzed, taking into account the absorbing characteristics of the plasma boundary and their effect on scattering of such waves. Assuming a frequency of incident radiation higher than the plasma frequency of electrons, the scattered radiation is treated in the hydrodynamic approximation and its energy characteristics are averaged statistically upon inclusion of the correlation function for sources of electron concentration fluctuations. This correlation function and the dynamic form factor characterizing noncoherent reflection are calculated in the diffusion approximation, assuming a correlation time much longer than the mean time of free electron flight. The differential reflection coefficients are calculated analytically from the differential cross-sections for scattering, whereupon their frequency characteristic and angular distributions are calculated numerically for s-polarized waves and p-polarized waves normally or obliquely incident on a semibounded system of diffusing particles. Figures 7; references 30.

### Real-Time Bilateral Signal Transformation

907K0040a *IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE* in Russian No 8, Aug 89, pp 6-8

[Article by Z. D. Lerner]

[Abstract] This study demonstrates the application of a transversal filter to real-time bilateral Hilbert signal transformation. The analysis reveals that the accuracy of the Hilbert transform implemented by the transversal filter is greater than in the case of an exponential



inverter-converter. In this case the transversal filter is implemented as a multitap delay line, a weighting unit, and an adder.

**Sequential Interframe Multiple State Measurement Identification for Application to Dynamic Objects**

907K0040b IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian No 8, Aug 89, pp 39-42

[Article by A. V. Ekalo]

[Abstract] This study examines parametric families of feasible sequential suboptimum measurement identification algorithms that conserve the structure of an optimum identification algorithm for application to multiple state measurements of dynamic objects. An upper limit is placed on the number of analyzed hypotheses for this purpose; the present analysis selects the L most probable hypotheses and stores these hypotheses after processing measurements of the next frame. The number of stored hypotheses is a parameter of this algorithm and is determined by the volume of calculation capabilities assigned to the algorithm. The primary advantage of the suboptimum identification algorithms examined in this study is that identification is implemented jointly for all objects while substantially reducing the total number of hypotheses. The statistical modeling results indicate that a near optimum measurement identification is achieved in this case.

**Multisize Component Distribution Subsystem in a Computer-Aided Topology Design System**

907K0040c IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian No 8, Aug 89, pp 43-48

[Article by O. I. Belobaba, A. L. Kuznetsov]

[Abstract] This article discusses the algorithms used for multisize component distribution and placement in the LITMO-2/CM industrial computer-aided topology design system. The study focuses on the multisize component distribution algorithm and the size distribution algorithm. An optimization of element classification is given together with the program implementation of the multisize component distribution algorithm. The program is implemented as a FORTRAN program package for the SM computer running on the RSX operating system. The load module occupies 28 K of RAM. The program developed in the study makes it possible to establish a component placement strategy and to select one of three criteria for selection of an optimum position and to then generate the algorithm for selecting the next component for placement.

**Design of an Industrial Vision System for Object Recognition Based on Follow Scanning**

907K0040D Moscow IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: PRIBOROSTROYENIYE Russian No 8, Aug 89, pp 67-70

[Article by Ye. I. Kovrigin, V. S. Chernyshev]

[Abstract] This article discusses the techniques used to implement an industrial vision system for object recognition based on follow scanning in which the industrial vision system utilizes, for each projection, video signal extrema detectors, a controller, and a decision unit which implements an object recognition algorithm developed in the study. The study carries out an experimental test of the moving image follow speed and determines its geometrical characteristics. The shadow method of imaging is used by employing laser beam illumination with a rotating glass disk placed perpendicular to the laser beam. The tracked figure and video signal parameters were monitored by means of an oscilloscope in the follow mode. The minimum image scan time across the photocathode where a good follow quality was achieved was 1 ms.

UDC 621.317.374(083.76)

**Special Government Standard of Unit Phase Angle between Two Voltages Covering  $1 \times 10^{-2}$ - $2 \times 10^7$  Hz Frequency Range**

907K0029A Moscow IZMERITELNAYA TEKHNIKA, No 8, Aug 89 pp 3-5

[Article by S. A. Kravchenko, A. A. Anepir, Yu. I. Kazimov, S. O. Krasavina, V. Ye. Novoderzhkin, G. S. Mikhaylova, D. A. Sirotenko, A. G. Filyuta, V. V. Fomenkov, S. I. Khakhamova, and I. Kh. Shokhor]

[Abstract] A new USSR Government Standard GET 61-88 of unit phase angle between two voltages covering the  $1 \times 10^{-2}$ - $2 \times 10^7$  Hz frequency range, certified in December 1988, replaces the current GET 61-74. The superseded standard was designed for testing at the 1000 Hz frequency and is already not sufficiently accurate at frequencies down to 1 Hz and up to 2 kHz as well as for large phase angles. The new standard consists of a reference phase meter, a set of devices reproducing the unit phase angles by three different methods at  $10^{-2}$ ,  $10^3$ ,  $10^5$  Hz, at 1 MHz, and at 10, 20, 30 MHz respectively, an automatic comparator, a reference phase meter-calibrator, adjustable and fixed frequency dividers, digital-to-analog converters, a computer-device device for automating the control of all measurements, and a set of maximum-accuracy certification phase meters. Introduction of this new standard should contribute to the national economy a saving of 4.635 million rubles over a period of 10 years. The standard is compared with several foreign standards of unit phase angle, including the basic National Bureau of Standards (USA) standard. Figures 2; tables 2; references 15.

UDC 681.2.001.4:531.717

**Interference-Type Apparatus for Checking up to 200 mm Long Stroke Gages***907K0029B Moscow IZMERITELNAYA TEKNIKA, No 8, Aug 89 pp 21-22*

[Article by L.Yu. Abramova, V.M. Baratov, G.V. Simakhina, and A.V. Eydinov]

[Abstract] An interference-type apparatus has been developed at the All-Union Scientific Research Institute of Metrology imeni D.I. Mendeleyev for checking up to 200 mm long master stroke gages. It consists of a Michelson laser interferometer with a built-in interference-type refractometer and two trihedral reflectors (one fixed, one movable), its He-Ne laser having been stabilized with respect to the intensity difference between two orthogonal modes, also a guidance system with two photoelectron microscopes, an electronic readout device, a computer loading device, a panel with heat measuring instruments, a set of drives, and a control unit. The apparatus was tested for accuracy, repeatability, and stability, also for systematic error caused by deviation from straight vertical and horizontal travel of the reflectorcarriage. For this purpose, a 200 mm long chamber with walls made of CrNbMn alloys steel was first filled with air and then evacuated down to 0.003 mm Hg pressure. Figures 2; references 3.

UDC 681.2:535.3

**Service Standard of Unit Pulsed-Laser Radiation Energy***907K0029C Moscow IZMERITELNAYA TEKNIKA in Russian No 8, Aug 89 pp 29-30*

[Article by G. L. Kabanov, S. A. Kaufman, and A. A. Liberman]

[Abstract] A service standard of unit pulsed-laser radiation energy is proposed which will cover a much wider range than the existing Special Government Standard, for storage and for transfer to reference energy meters. It combines several service standards which cover a different energy range each, and it includes a calibrated energy divider which delivers a small fraction of the total energy (0.2-2 J) to the energy measuring part. It is designed for operation at the 10.6  $\mu\text{m}$  wavelength and covers the 0.8-1.2 kJ energy range with an r.m.s. error not larger than 1%. The energy measuring part consists of a wide-aperture primary instrument transducer with an output voltmeter, an electrical calibrating system, and a recording device with digital program control. The unit transferring part consists of an LGN-707 continuous-wave laser, an electromechanical shutter which converts continuous radiation into pulses of 102 s duration, an absorber of reflected radiation, a long-focus (3000 cm) NaCl lens, and a calibrated energy divider is a diffraction phase grating. The error of such a divider-grating consists of two components, one being due to inaccuracy of

certification test measurements and one being due to changes in spatial and polarization characteristics of the laser radiation. With proper quality control, it is feasible to select a divider-grating with a total error of energy unit transfer not exceeding 0.8%. Figures 1; references 5.

UDC 681.118.4:535.214

**Dynamic Calibration of Radiometer Based on Nonisothermal Black-Body Model***907K0029D IZMERITELNAYA TEKNIKA in Russian No 8, Aug 89 pp 42-44*

[Article by K. A. Butakov, S. V. Butakova, and A. A. Ivanov]

[Abstract] A method of calibrating a radiometer with an antenna is described which involves use of a black-body model with a nonisothermal radiating surface as source of microwave noise. The model is a hollow body having one opening through which microwave noise is emitted into free space and having its inside surface lined with a radiation absorbing material. Three thermocouples are embedded in this lining and connected to thermoe.m.f. indicator, typically an electronic digital voltmeter. The cavity lining is heated by three heater elements spread on the outside surface of the body and connected individually to a common power supply through a commutator switch. A performance and error analysis based on calculation of radiometer and thermocouple heating-cooling temperature transients during the calibration process indicates that this method of calibration can be more accurate than the conventional method based on intrinsic radiometer noise. The key parameters of a black-body model are its emissivity and slopes. Figures 2; references 11.

**Modern Trends in the Development of Transducer Equipment***907K0030A Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 7, Jul 89 pp 16-17*

[Article by Ye. P. Osadchiy]

[Abstract] This general review of the current status of the transducer design and manufacturing industry in the USSR and abroad notes the increasing demand for transducers in equipment and instruments in modern science and technology. Special attention is devoted to the use of microelectronic technology in the design and fabrication of transducers. The article cites numerous examples where semiconductor or wafer technology can be used to replace standard electromechanical wired transducers; for example, electromagnetic transducers employing electrical windings can be replaced by transducers with deposited or etched windings. Quartz oscillators with appropriate polarization axes induced in the fabrication process are also discussed. The article discusses in some detail the systems approach to transducer design whereby structural, engineering, measurement,



data, and algorithmic compatibility is sought. Companies such as Bruel and Kjaer, Endevco, Kistler are cited as companies where such an approach has been successful to some degree. Transducer reliability is also discussed together with new possible applications of transducers in the national economy.

#### Surface Acoustical Wave Transducers

907K0030B Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 89 pp 18-19

[Article by V. Yu. Snitko]

[Abstract] This article analyzes the design principles and possible applications of surface acoustical wave transducers. The fundamental principle underlying the design of such transducers is the variable rate of propagation of surface acoustical waves in solids whereby the surface acoustical wave transducer measures the change in the velocity of the surface acoustical waves under external mechanical, acoustical, electrical, thermal, optical, chemical, etc. actions. A surface acoustical wave prototype is fabricated for the analysis carried out in this study; this device contains a piezoelectric substrate, an interdigital transducer for generating surface acoustical waves in the acoustic channel, an RF oscillator, a mobile plate containing the interdigital transducer detector and a signal processor. Equations are derived for analyzing the function and performance of this device and analysis indicates that the error of distance measurement is dependent on the error of wave velocity and propagation time measurement. The study also analyzes a variety of surface acoustical wave transducers for various measurement and testing applications, including pressure measurement instruments, accelerometers, linear displacement transducers, etc. Some possible future modifications and applications are also mentioned.

#### Transducers Based on Heteroepitaxial Germanium Films Deposited on Gallium Arsenide

907K0030D Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 89 pp 29-30

[Article by V. F. Mitin, S. V. Korytsev, Yu. M. Shvarts, Yu. A. Tkhorik]

[Abstract] Performance analysis was conducted on Hall transducers based on thin heteroepitaxial germanium films deposited on semi-insulating gallium arsenide substrates. The results suggest that it is possible to fabricate semiconductor film transducers (broadband temperature, stress, and magnetic field induction transducers) using a single manufacturing principle, thereby making it possible to integrate transducer fabrication technology.

#### Resistive Transducers Based on Gallium Arsenide-Phosphide Single Crystals

907K0030E Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 7, Jul 89 pp 30-31

[Article by A. S. Ostrovskaya, S. S. Varshava]

[Abstract] Semiconductor devices based on a gallium arsenide-phosphide solid solution are useful for applica-

tions to miniature resistive transducers. The solid solutions have a relatively high bandgap and are highly resistant to extreme temperatures. The electrical, galvanomagnetic and photoelectric properties of the gallium arsenide-phosphide single crystal specimens were investigated, as well as the effect of stress and deformation (uniaxial compression and distension and hydrostatic pressure). The study also reports results from analyses of the photoelectric properties of the specimens as well as their thermometric properties. The analysis suggests that copper-doped specimens with a composition of  $x = 0.4$  are promising for application to precision thermistors in the 273-573 K range and to thermal anemometers operating over a broad temperature range.

UDC 621.396.969.1(024)

#### Book: Principles of Very Wide Band Radar Measurements

907K0231A Moscow OSNOVY  
SVERKSHIROKOPOLOSNYKH  
RADIOLOKATSIONNYKH IZMERENIY in Russian  
1989 pp 2-6—FOR OFFICIAL USE ONLY

[Article by L. Yu. Astanin, A. A. Kostylev]

[Text] The principles of radiation, scattering and reception of very wide band signals are studied. Methods are developed for analysis of the transformation of signals in the radio-frequency circuits of high information capacity radar sets. Primary attention is given to investigation of the radar characteristics of targets. Simple, clear and rather precise methods are presented for analysis of the unsteady scattering of electromagnetic waves on objects of various shapes. Mathematical models of the scattering are introduced, particularly models in the space of states. The principles involved in the design of very wide band radar devices for measuring of characteristics and signal statistical processing algorithms based on the method of regularization are presented.

An experimental measurement and computing system is described with a range resolution of about 2.5 cm. Problems are discussed, related to the use of measured or computed radar characteristics to model radar sets, recognize targets and generate their radar images.

The book is intended for scientific workers in the area of radar and radio physics. It may also be useful to graduate students and instructors at the university level.

There are four tables, 81 illustrations and 134 bibliographic references.

#### Foreword

About a quarter century ago the first studies were published on the use of very wide band signals [47]. Since that time, many researchers have produced a number of fundamental results relating to the theoretical principles of unsteady electrodynamics and to the principles of the

design of VWB radar systems. They have served as a basis for the creation of VWB radars with various missions: detection and recognition of spacecraft, missiles and aircraft, surface ships and submarines, mines, tunnels, archeological, geological and other subsurface objects; the construction of three-dimensional radar images, et cetera [6, 43, 52, 73, 77, 90, 105, 125]. The variety of practical applications and the significant level of their development indicate the maturing of very wide band radar.

There have been more than a thousand publications on VWB radar and related areas of electronics, some of which are listed, for example, in [6-8, 11, 25, 43, 52, 53, 73, 77, 91, 105, 125, and 131]. However, there have been practically no summary works, discussing the major tasks of the theoretical and experimental investigation of VWB radars, their creation and utilization from a common standpoint. The basic purpose of the present book is to summarize known achievements in the major areas of VWB radar and discuss some original theoretical and experimental results. Primary attention is given to investigation of the radar characteristics of targets illuminated by VWB signals, or more precisely, to two aspects: the development and demonstration of simple, clear and rather accurate methods for analysis of the scattering, radiation, reception and transformation of VWB signals in a radar circuit and the development of the design principles for VWB radar devices to measure the scattering characteristics of targets, including problems related to the creation of effective signal processing algorithms. Due to the limited size of the book, the authors, contrary to their initial intent, did not include studies in a number of related areas in which the specifics of VWB signals are no less important than in the areas discussed. This is particularly true of measurements of the coordinate and velocity parameters of radar targets which, we feel, deserve special analysis.

The authors invite comments on the book to be sent to "Radio i Svyaz" press.

## Introduction

The development and introduction of very wide band systems represent a qualitative leap forward in the development of radar. The use of a VWB radio signal, the spectral width of which  $\Delta f$  is comparable to its center frequency  $f_0$  ( $\Delta f/f_0$  is on the order of 1) allows problems of radar observation as detection and recognition of targets and construction of their radar images to be solved on a higher level. Important here is not only the great absolute width of the VWB signal spectrum, extending beyond 1 GHz, but also the significant relative width ( $\Delta f/f_0$ ).

The rejection of a traditional postulate of radar engineering—the use of a narrow-band probing signal—requires reanalysis of many of the basic concepts of radar engineering, starting with the principles of radiation, reception and processing of signals, analysis of the scattering

of signals by radar targets and extending through the mathematical models used for analysis and synthesis of radar systems.

In creating a theoretical model for a VWB radio signal, it is not suitable to use the traditional characteristics which simplify the description of narrow-band signals, such as the envelope and the phase. Furthermore, the usual simplified representation of a signal, based on replacement of the Hilbert transform with a simple signal phase shift, introduces significant errors in this case. Therefore the description of VWB signals requires the use of real functions of time and their spectral functions. The solution of the problems of radar observation correspondingly involves analysis of changes in the shape of signals during radiation, scattering and reception, requiring the use of the corresponding mathematical apparatus.

New conceptions concerning the mechanism of scattering, radiation and reception of electromagnetic waves by radar targets and antennas have been formulated in the analysis of the unsteady electrodynamic problems related to the use of VWB probing signals. The use of new methods, particularly methods of generation of solutions in the time area, has allowed it to be established that the basic contribution to scattering of a field by a target is made by individual, local scattering or radiation centers, the locations and properties of which are determined by the geometry of the electrodynamic structure and the form of the VWB signal [6, 7, 11, 13, 22, 25, 38, 131]. It is important to note that the methods developed not only include classical electrodynamics as a particular case, but also feature comparative simplicity and clarity of the physical sense of their solutions [131].

The development of the space-time equivalency principle has allowed the target and antenna system to be analyzed as generalized filters, the characteristics of which are determined by the spatial structure of the object and the time structure of the signal. Basic distinctions have been revealed between the properties of antennas in radiation and reception modes, between broad band and wide band systems and many other specifics of the scattering and radiation of VWB signals [6, 7, 99, 131].

The basic results in applied unsteady electrodynamics, serving as a basis for the creation of VWB radar analysis and synthesis methods, are related to the use of the apparatus of the general theory of linear dynamic systems. Its origin was laid down by the works of Kenno, Cosgriff and Moffat [47, 6]. The determination of the fundamental relationship among the peak, transient and other scattering characteristics of an object and its shape, dimensions and orientation have allowed statement and solution of the reverse problem of scattering at a qualitatively new level: determination of the parameters of a scattering object from the measured field. This is the

most general problem of all problems of radar observation (detection, measurement of the parameters of position and motion, identification, classification and recognition of objects). Therefore, the use of VWB signals leads to an increase in the quality of solution of particular radar problems.

We note that the use of the apparatus of linear systems in electrodynamics, particularly peak characteristics, leads to restudy of yet another classical position—the division of the frequency band into the Rayleigh, resonant and high-frequency areas. The peak characteristic describes both the high-frequency properties of a scattering object, manifested as the presence of local scattering centers, and the resonant properties, revealing the interaction of these centers with each other. The resolution of the corresponding elements of the peak characteristic over time allows these properties to be studied separately.

A further development of these ideas is found in the methods of decomposition and approximation of the peak characteristics of targets developed here, based on the properties of localness and other specifics of the scattering of unsteady electromagnetic waves.

Considering current trends in the development of systems theory for the description of radar targets and other elements of a radar system, we shall study models in the form of differential equations in input-output variables and state variables. These models, particularly in the space of states, have a number of properties attractive to the engineer. First of all, in contrast to other radar target models, they directly indicate the method of modeling reflected signals, defining the structure and parameters of the physical target models implemented as analog computers or special simulators containing only simple elements—adders, integrators, and amplifiers (attenuators). Similarly, when digital computers are used to model targets a description by means of differential equations in state variables allows direct utilization of existing highly effective algorithms and programs for the solution of differential equations in Cauchy form, as well as synthesis of optimal processing algorithms for a much broader class of signals and noise than the other forms of description, and these algorithms are better suited for computer implementation.

The introduction of VWB signals requires a significant alteration of the principles of design of radar equipment. Most elements and units of narrow-band equipment used for the generation, transformation and reception of radar signals are unsuitable. This is particularly true of resonant elements: bridges and circulators, klystron amplifiers, most matching devices, et cetera. As a rule, frequency transformation is impossible during generation and reception of signals. VWB pulse signals (of nanosecond and subnanosecond length) cannot be detected upon reception. New principles are therefore required for generation, reception and processing of these radar signals. The uniqueness of the new methods is particularly clearly seen in the creation of radars using pulsed VWB signals: to form coherent subnanosecond

radio pulses, unusual shock excitation methods are used for antennas or wide band electronic devices, while reception utilizes stroboscopic time-scale conversion of VWB signals, et cetera. It is clear that the time has arrived for the development of special VWB radar electronic equipment.

An important distinguishing feature of VWB radar is the necessity in principle for the use of a well developed computer system. This is because first of all the creation of VWB radar equipment satisfying the rigid requirements for the uniform frequency characteristic of the SHF circuit over a frequency band of several gigahertz is technically impossible or economically unjustified. Therefore, the computer system of the radar must be used to correct the characteristics of the equipment. Secondly, in solving the inverse electrodynamic problem for which VWB radar systems are designed, a tremendous volume of information is extracted from the fine structure of the scattered unsteady field, and must be processed by computer to achieve the required accuracy. The specific nature of such problems as recognition of radar objects and construction of their images requires the use of complex solution algorithms.

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### **Book: Principles of Very Wide Band Radar Measurements**

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SVERKSHIROKOPOLOSNYKH  
RADIOLOKATSIONNYKH IZMERENIY in Russian  
Book, 1989 pp 190-191—FOR OFFICIAL USE ONLY

[Article by L. Yu. Astanin, A. A. Kostylev]

[Text]

### **Table of Contents**

Foreword .....	3
Introduction .....	4
Chapter 1. Mathematical Models of Very Wide Band Radar Signals and Theory of Their Transformation in Linear Systems .....	7
1.1. Definition and properties of very wide band signals .....	7
1.2. Possibility of using complex representation of very wide band radio signals .....	17
1.3. Representation of very wide band radio signals as real functions of time.....	24
1.4. Energy and information characteristics of very wide band signals. General frequency.....	27
Chapter 2. Radar Characteristics of Targets for Very Wide Band Signals .....	33

2.1. Methods of modeling radar characteristics when very wide band signals are used .....	33
2.2. Basic properties of very wide band radar characteristics .....	44
2.3. Global and local properties of radar characteristics .....	55
2.4. Methods of decomposition of system characteristics of radar targets .....	60
2.5. Relationship of pulse characteristic to radar target shape .....	64
Chapter 3. Theory of Scattering of Very Wide Band Signals by Radar Targets .....	67
3.1. Methods of solving unsteady electrodynamic problems .....	67
3.2. Scattering of very wide band radio signals on the edge of a conducting screen .....	71
3.3. Pulse characteristics of model objects .....	80
3.4. Pulse characteristics of objects of finite size .....	85
3.5. Scattering of very wide band radio signals by bodies with smooth surfaces .....	93
Chapter 4. Very Wide Band Antenna Characteristics .....	95
4.1. Determination of very wide band antenna characteristics in radiation and reception. Characteristics of elementary radiators .....	95
4.2. Radiation characteristics of a balanced dipole .....	99
4.3. Unsteady radiation of aperture antenna .....	101
4.4. Radiation and reception characteristics of an arbitrary antenna .....	103
4.5. General specifics of radiation and reception of very wide band signals .....	108
Chapter 5. Principles of Design of Radar Measurement Devices Using Very Wide Band Signals .....	111
5.1. Basic types of radar characteristic measurement devices .....	111
5.2. Design principles of very wide band probing signal generators .....	118
5.3. Design principles of very wide band radar receiving devices .....	126
5.4. Energy potential of radar using very wide band signals .....	132
5.5. Automated very wide band radar measurement-computer system .....	134
Chapter 6. Methods of Processing Signals upon Measurement of Very Wide Band Radar Characteristics .....	141

6.1. Identification equations .....	141
6.2. The method of regularization as a basis for solving problems of estimating very wide band radar characteristics .....	147
6.3. Regularized estimates of very wide band radar characteristics .....	157
Chapter 7. Use of Very Wide Band Radar Characteristics .....	161
7.1. Modeling of radar .....	161
7.2. Target recognition .....	171
7.3. Formation of radar images .....	177
Conclusions .....	182
References .....	184

### Performance Evaluation of Semiconductor Ballast Systems

907K0003c Moscow SVETOTEKHNIKA in Russian No 9, Sep 89, pp 9- 11

[Article by Ye. G. Ovsepyants, N. N. Shkuro]

[Abstract] A practical technique has been developed for evaluating the performance of a semiconductor ballast system for fluorescent lamps. The methodology identifies a number of parameters that are then estimated and plotted in the performance analysis. The parameters include the nominal power of the fluorescent lamp using an electromagnetic ballast system at 50 Hz; the nominal luminous flux of the fluorescent lamp using the electromagnetic ballast system at a frequency of 50 Hz; the power variation factor from a semiconductor ballast system at a high frequency; the coefficient reflecting the variation in luminous flux of the fluorescent lamp employing a semiconductor ballast system at a high frequency and a coefficient that accounts for power losses in the equipment. The study also develops a modified technique for calculating the efficiency of a semiconductor ballast system for fluorescent lamps and presents evaluation results together with nomograms for evaluating the effectiveness of the system for various annual hours of use. The system is used to select raw data required to analyze the utility of specific semiconductor ballast systems for fluorescent lamps and makes it possible to obtain the necessary information on both the electrical and light engineering parameters of the new semiconductor ballast-fluorescent lamp system.

### Methods of Improving Capacitive Pressure and Acceleration Transducers

907K0063a Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 9, Sep 89, pp 7-8

[Article by V. M. Artemov, E. A. Kudryashov, Ye. S. Levshina, V. S. Moiseychenko]

[Abstract] This article discusses the potential of small-gap capacitive transducers and proposes a number of structural and circuit engineering design modifications



for capacitive acceleration and pressure transducers. A number of small-gap and variable-gap transducer designs are examined and the variability of the amplitude-frequency response of the resulting transducers is analyzed as well as the dependence of the frequency on the membrane radius. Structures in which the output voltage from the pressure (acceleration) transducers is injected to the electrodes of an electrostatic transducer through hyperbolic network are proposed. Structures with pulse-time pressure equilization are discussed and appropriate schematics and block diagrams are provided.

#### **Transverse Piezoelectric Elements for Force and Pressure Transducers**

907K0063b Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 9, Sep 89, pp 9-10

[Article by E. A. Kudryashov, V. Ye. Mager, Sh. M. Rafikov]

[Abstract] This article discusses certain modifications of standard applications of transverse quartz piezoelectric elements to pressure and force transducers. Standard pressure and force transducer designs employing transverse piezoelements are discussed and analyzed and the stability and strength limitations of such devices together with manufacturing limitations have prompted the authors to develop alternate cylindrical piezoelectric elements for such applications of dimensions  $h = 11$  mm,  $a = 1$  mm with a central radius of  $r = 4$  mm. These piezoelectric elements were tested on a direct loader producing forces of up to 100 kg. The conversion error from repeated loading and unloading was less than 0.3 percent. The authors also propose new transverse quartz piezoelectric elements fabricated as X-cut disks under radial load. A performance analysis of these elements and relevant calculations are provided. The study also discusses future directions for the development of piezoelectric transducers such as the use of new piezoelectric materials including lithium niobate whose sensitivity and elasticity properties lie between those of quartz and piezoceramics. The test results from this study made it possible to substantially enhance the accuracy and sensitivity of the individual piezoelectric transducers by using the newly-fabricated transverse piezoelectric elements (cylindrical and disk-shaped, quartz and lithium niobate elements) in the transducer designs.

#### **Thermal Resonance Transducers**

907K0063c Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 9, Sep 89, pp 11-12

[Article by E. A. Kudryashov]

[Abstract] New thermal resonance transducer designs together with a method of fabricating active power comparison converters using such transducers are proposed. These converters are used to convert average input signal power into a pulse repetition rate for a.c. precision digital comparison instruments, including ammeters, voltmeters, wattmeters, and power meters.

The various types of thermal resonance transducer designs are presented and analyzed. A differential fabrication technique is used in such transducers to suppress the initial frequency and reduce the dependence of the output frequency on the environmental temperature. This method involves using two thermal resonance transducers in the copper housing of the thermal filter or thermostat. This makes it possible to reduce short-term difference frequency instability of such devices to .1-1 Hz and such thermal resonance transducers are promising for use in digital instruments by virtue of their high sensitivity, resolution, and frequency output. The study also considered possible applications of the active transducers in digital wattmeters and power meters. The error of a transducer design including electronic sum-difference transducers and two active comparison transducers was of the order of 0.02 percent. The authors are continuing efforts to develop more advanced structural techniques for enhancing the accuracy of digital power comparators based on thermal resonance transducers.

#### **Computer-Aided Start-to-Finish Mechanical Transducer Design Systems**

907K0063d Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 9, Sep 89, pp 30-32

[Article by E. M. Shmakov]

[Abstract] This article presents an approach to developing computer-aided design systems that support start-to-finish design of mechanical transducers. The essence of the design process involves utilizing the computer to select a set of generating models, constraint conditions, and relational conditions for establishing, in the ideal case, a single design model followed by the material object - the transducer - if the suitability of its practical implementation is indicated by the physical feasibility indicators. In this study the formalized description of the design process is obtained by means of semantic nets and set theory. The interactive computer-aided mechanical transducer design system proposed in this study can be used for several applications, including substantiation of a design need, the search for the most appropriate prototype to match a given technical design, the development of the physical principle of operation as a network of transducers that convert a given measured mechanical quantity into a chosen electrical output quantity while observing constraints on the properties of such a transducer.

#### **Paraphase Logic Elements as a Promising Element Base for Ultrahighspeed Digital Large-Scale Integrated Circuits**

907K0001A Moscow *MIKROELEKTRONIKA* in Russian Vol 18, No 9, Sep 89, pp 387-398

[Article by V. V. Bochkarev, I. I. Shagurin]

[Abstract] This study is devoted to an analysis of the design principles, characteristics, specifications, and per-

formance of paraphase logic elements for use in ultrahighspeed digital large-scale integrated circuits. The performance of such elements in standard circuits such as current sources and level converters are discussed and are compared to switched-current logic and emitter coupled logic elements. Standard digital devices including D-flip-flops, multiplexers, decoders, adders, arithmetic logic devices, ten step counters etc. based on the three different types of logic (switched current logic, emitter coupled logic, and paraphase logic) are compared. The data provided in this study suggest that in terms of logic capabilities the paraphase logic elements are similar to both switched current and emitter coupled logic elements. Paraphase logic elements can reduce the number of elements by a factor of 3-4 and reduce the number of logic stages by a factor of 2-3 compared to analogous devices based on two-input NAND elements. Overall paraphase logic elements can be used to reduce the logic signal differential in modern digital large-scale integrated circuits to a theoretical limit of approximately 100 mV. This makes it possible to obtain a switching delay 3-4 times shorter than for switched current or emitter coupled logic elements used in ultrahighspeed large-scale integrated circuits at identical power levels and fabrication technologies.

#### **Modeling and Calculation of the Mechanical Stresses in Integrated Circuit Structures**

907k0001B Moscow MIKROELEKTRONIKA  
in Russian Vol 18 No 9, Sep 89, pp 399-405

[Article by A. A. Gorbatshevich, Yu. A. Parmenov, A. A. Reznik, S. N. Chayka]

[Abstract] This study makes an initial attempt to analyze mechanical stresses in integrated circuit structures accounting for the wide variety of processes occurring in their fabrication, thereby making it possible to find the residual and temperature stress fields at any intermediate or final integrated circuit fabrication stage. The analysis involves developing a model for calculating stresses in a composite elastic medium in the presence of a temperature field. A numerical analysis of thin film structures using the SIGMA program developed here made it possible to establish two qualitatively different states in the film-substrate system: bending and extrusion. In  $\text{Si}_3\text{N}_4$ - $\text{SiO}_2$ -Si structures it is possible to concentrate the stresses in the films by appropriate selection of the thicknesses of the  $\text{Si}_3\text{N}_4$  and  $\text{SiO}_2$  films, thereby reducing the substrate stresses. the SIGMA program developed here in conjunction with the model can be used to analyze multilayered integrated circuit structures and digital devices with any surface relief in any shape, including nonplanar surfaces containing local cracks, vacancies, and inclusions.

#### **Application of Capacitive Techniques to Monitoring Epitaxial GaAs Structures Designed for Fabrication of Integrated Circuits and Schottky-Barrier FETs**

907K0001C Moscow MIKROELEKTRONIKA  
in Russian Vol 18 No 9, Sep 89, pp 416-420

[Article by V. Ya. Prints, V. A. Samoylov]

[Abstract] This study considers the possibility of using the C-V characteristics of semiconductor structures to evaluate the electrical properties of the buffer layers and film-substrate interface in these structures used for fabrication of integrated circuits and Schottky-barrier FETs. The study focuses on epitaxial gallium arsenide structures grown from metallorganic compounds. The epitaxial layers had the following thicknesses: buffer layer on sem-insulating substrate: approximately 1.5  $\mu\text{m}$ ; active n-layer: 0.2-0.3  $\mu\text{m}$ ; contact  $n^+$ -layer: 0.2-0.3  $\mu\text{m}$ . The doping profile was measured by means of profilometers. Measurements of the low-frequency C-V characteristics using ohmic contacts attached to the p-layer and the n-layer were employed to recover standard electron concentration profiles in the Schottky-barrier FET and integrated circuit structures. The analysis revealed that it is possible to estimate the charge carrier concentration in such layers by comparing the experimental and theoretical relations plotting the number of carriers as a function of the thickness in micrometers. Singular points were also discovered in the charge carrier concentration profile near the film-substrate interface; it was determined that these singularities were caused by p-type conducting layers near the interface.

#### **Equipment Set for Welding Training of Splicers for Assembly of KOMS Optical Cable**

907K0033a Moscow VESTNIK SVYAZI in Russian  
No 8, Aug 89 p 16

[Unattributed article]

[Abstract] This article discusses an equipment set used for optical cable welding training and consists of a display for analyzing optical cable welding quality, a power supply for the welder, a normalization device used to generate radiation on the cable with a mode composition corresponding to the established mode composition for the given type of fiber and for outputting modes propagating on the optical fiber cladding. Specifications for these units are provided.



**The IKM-12U Secondary Digital Transmission System Equipment**

907K0059a Moscow ELEKTROSVYAZ in Russian  
No. 10, Oct 89, pp 1-7

[Article by L. S. Levin, A. M. Mekkel, V. A. Oksman]

[Abstract] This article analyzes the design, layout, performance, and specifications of the IKM-120 secondary digital transmission system equipment which is a modernized version of the IKM-120A system and is designed for use on ZK and MKS single-quad and multiquad balanced cables on digital transmission systems. The IKM-120U is a fourth generation digital transmission system and this unit has certain advantages over the IKM-120 with respect to size, power consumption, reliability, and maintainability. In addition to improved noise immunity the design aspects of the overall system have been substantially simplified by virtue of an increase in the tolerance of variations in the lengths of regeneration sections. The IKM-120U system consists of supergroup channel generation equipment, terminal and intermediate line circuit equipment, and test instruments. All the equipment employs modern components (CMOS components and Schottky-effect structures) and special-purpose hybrid integrated circuits. The IKM-120U connector specifications satisfy CCITT Recommendation G.703 and GOST 26886-86. Select specifications for the IKM-120U include: number of voice grade frequency channels: 120; transmission rate of input digital stream, kbits/sec: 2048; relative input clock frequency instability: plus or minus 3 times  $10^{-5}$ ; group stream transmission stream, kbits/sec: 8448.

**Evaluation of the Accuracy of the Minimum Capital Expenditure Criterion for Calculating the Number of Channels on a Long-Distance Telephone Network**

907K0059b Moscow ELEKTROSVYAZ in Russian  
No 10, Oct 89, pp 11-16

[Article by V. G. Dedoborsch, V. A. Ershov, L. D. Ilina, G. B. Levina, N. A. Bondar]

[Abstract] This study evaluates the accuracy of the minimum capital expenditure criterion used in determining the number of channels installed on long-distance telephone networks. The evaluation is based on a random search technique which is used to analyze individual sections of the long-distance telephone network without any simplifying assumptions. The study then derives an efficiency function optimization algorithm to optimize the network efficiency function. A special technique from so-called local step search techniques is used for this purpose. The study provides a sample network optimized by means of the random search technique, while a channel matrix corresponding to 182 search steps is also provided. The analysis carried out in this study revealed that previous assumptions made in deriving analysis models based on minimum capital outlay result in substantial errors in the distribution of channel groups within the communications network.

**Signal Generation Problems in a Digital Radio Broadcasting System**

907K0059d Moscow ELEKTROSVYAZ in Russian  
No 10, Oct 89, pp 31-34

[Article by M. Ya. Lesman, Yu. B. Okunev, L. M. Fink]

[Abstract] This study considers the various aspects of designing digital radio broadcasting systems, including the techniques used to select the analog-to-digital signal conversion method and the procedures for selecting the type of modulation and the signal detection methods as well as a noise-immune code and decoding methods, etc. Given the broad variety of problems involved in digital radio broadcasting the present article limits its analysis to radio broadcast multiplexing techniques and a comparative analysis of the frequency efficiency of a digital radio broadcasting system and an analog UHF FM broadcasting system. The analysis assumes that the digital radio broadcasting system utilizes spectral acoustic signal compression methods, thereby making it possible to reduce the digital stream transmission speed to 100-130 kbits/sec for monaural broadcasting and single or double phase difference modulation. The study suggests that high-quality stereophonic ground-based and satellite digital radio broadcasting is best implemented by means of frequency division multiplexing of programs and multifrequency transmission of the digital stream of each program. The study finds that the best frequency efficiency is achieved by using orthogonal signals.

**Determination of the Number of Shortwave Radio Broadcasting Stations Operating Simultaneously at a Common Frequency**

907K0059d Moscow ELEKTROSVYAZ in Russian  
No 10, Oct 89, pp 34-37

[Article by V. G. Dotolev, G. M. Kuzkina, O. I. Sergeev, A. T. Titov]

[Abstract] This article is devoted to an estimation of the frequency utility coefficient of shortwave radio broadcasting stations, which is defined by the authors as the number of radio broadcasting stations that can operate simultaneously at a common frequency while maintaining acceptable safety signal-to-interference ratios within their service regions. A number of network models with specific constraints are used in order to determine the frequency utility coefficient for shortwave broadcasting stations. These models are simplified compared to actual conditions although they reflect standard radio broadcasting hardware, service regions, and characteristic types of networks. Model 1 employs unidirectional radio transmitters with a service region of 0-360° over 800-1500 km. Model 2 utilizes solely SGD 4/4RA directional antennas with the service region covering a range of 1000-3000 km in the direction of the antenna azimuth in skip conditions. Model 3 is the most general case of shortwave radio broadcasting where both antennas discussed above are used. The frequency utility coefficient is then calculated as a factor of type of

antenna, radiated power, service region, and safety signal-to-interference ratio. This modeling routine made it possible within the simplified conditions in this analysis to determine only the limits on the number of radio stations and to identify the primary dependences of the frequency utility coefficient on various engineering and physical conditions.

### **Metrologic Support of Fiber-Optic Communications Link Construction**

907K0066a Moscow VESTNIK SVYAZI in Russian  
No 10, Oct 89, pp 31-34

[Article by S. M. Vernik, S. F. Glagolev, A. M. Kuznetsov, V. B. Rudnitskiy, V. R. Sumkin]

[Abstract] The development, manufacture and introduction of instruments and test equipment for fiber-optic communications link construction and operation begun by the Leningrad Electrical Engineering Institute of Communications in 1986 will continue through 1990. The primary test instruments are the OR-1 and OR-2 optical reflectometers designed to replace the current foreign reflectometers in use in the USSR to test fiber-optic communications cables. The OR-1 and OR-2 are designed for use in field conditions in fiber-optic link construction and at municipal telephone network exchanges as well as attended and unattended stations in fiber-optic zone networks. The OR-3 and OR-4 optical reflectometers were designed for use on long-distance networks. These devices are similar in design to the OR-1 and OR-2 reflectometers, although their designs differed due to the reduction in the optical fiber core diameter and the lower backscatter signal level, which made it necessary to introduce digital signal processing in order to expand the dynamic range. The article also discusses an optical fiber transmission tester used to test construction lengths of optical cables by measuring the group signal propagation time, the average refractive index, the signal dispersion, attenuation, and backscatter distribution function. The study provides tables of standard applications of these instruments as well as their specifications.

### **Improving Printed Circuit Board Quality**

907K0066c Moscow VESTNIK SVYAZI in Russian  
No 10, Oct 89 pp 36-38

[Article by V. S. Demenkov, V. M. Yeskov]

[Abstract] The Minsk division of the Special Industrial Design Bureau is attempting to improve the quality of electroplating conductors in the fabrication of printed circuit boards. Preliminary operations on the chemical copper plating manufacturing line were found to be useful in enhancing adhesion; such operations include alkaline cleaning, pickling, and subetching. Specific component concentrations are recommended for the pickling solutions as well as the subetching process. The adhesion of the electroplated copper layer was found to depend on the composition and proper utilization of the

chemical copper coating solutions (PH, time and temperature of exposure to solution, continuous filtration and other elements). Selection of an optimum composition and conditions for copper electroplating were also found to be important. The study recommends the following composition for this process (grams/liter): copper sulfate: 200-230; sulfuric acid: 60-70; sodium chloride: 0.03-0.1; LTI additive: 0.1-0.2; OS-20 preparation: 0.2-0.3.

### **An Electronic Information Service for Municipal Telephone Networks**

907K0066d Moscow VESTNIK SVYAZI in Russian  
No 10, Oct 89, pp 38-40

[Article by B. S. Goldshteyn, B. F. Zhuravskiy, N. A. Peukhov]

[Abstract] An electronic information service has been created on the basis of a hardware set and software package developed by the Leningrad Division of the Central Scientific Research Institute of Communications. This electronic information service, which is installed on municipal telephone networks, provides a completely-accessible digital switching system offering call handling with program-controlled waiting periods and priorities. This particular system supports electronic switching and automatic retrieval of requested information and can operate with ten step, crossbar, and electronic automatic telephone exchanges as well as automatic long-distance telephone exchanges in various systems. The sample system discussed in the article is designed for a municipal telephone network with a capacity of up to 300,000 numbers. Such a system commonly includes an integrated call distribution stage, operator workstations, and a computerized information retrieval system. The component parts of this system are described and discussed together with the results from a performance analysis.

### **The Development of Satellite Communications and Broadcasting Systems Based on Large-Scale Space Platforms**

907K0102a Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 2-5

[Article by L. Ya. Kantor]

[Abstract] This article discusses possible designs of satellite communications and broadcasting systems employing large-scale space platforms for direct broadcasting to ground-based subscribers. The current satellites can be classified as large-scale space platforms under the following conditions: 1) the weight and capacity of power supplies used on board the spacecraft are greater than those presently used on existing spacecraft; 2) the large-scale space platform will contain several on-board repeaters for various services operating in different frequency bands and 3) highly directional antennas will be installed on the large-scale space platforms. The advantages of direct broadcast service from

large-scale space platforms are analyzed and are compared to the necessary costs associated with the development, launching, orbital injection, and operation of such platforms. Possible satellite and ground-based communications and broadcasting network configurations are discussed together with both direct telephone and television communications systems. It is determined that the primary condition for establishing suitability of large-scale space platforms will be cost per broadcast channel. Such platforms can also be used to set up long distance telephone lines within the Unified Automated Communications Network and for television broadcasting

#### **The DKD-400 Multifunction Digital Satellite Communications Equipment**

907K0102b Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 7-10

[Article by V. M. Dorofeev, Yu. F. Konovalov, S. N. Deryugin]

[Abstract] The DKD-400 multifunction system was developed at the "Radio" scientific-production association for satellite communications links employing frequency division multiplexing and multiple station access. The primary element in this system is a universal digital modem with a variable transmission rate capability and a low signal-to-noise ratio achieved by convolutional coding, Viterbi algorithm decoding, and coherent phase modulation as well as low-speed noise-immune analog-to-digital converters. The specifications of the equipment are as follows: operational frequency range, MHz: 52-88; frequency increment, kHz: 45; input and output carrier frequency signal levels, dBm: -25 to -40; pilot signal capture and rejection band, kHz: plus minus 40; transmission rate, kbits/sec: 32. The transmission methods used in the DKD-400 equipment make it possible to improve the noise immunity of voice grade frequency channels by 8-9 dB compared to analogous "Interchate" or Spade ("Intelsat") equipment. The system provides a signal-to-noise ratio within the demodulator band of 4-5 dB, therefore maintaining a high noise immunity of the signals relative to intermodulation noise which makes it possible to drive the repeater to a near saturation mode.

#### **Quality of Speech Transmission by Block Pulse-Code Modulation on Analog-Digital Satellite and Ground-Based Communications Channels**

907K0102c Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 10-13

[Article by V. P. Kokoshkin, N. I. Marinicheva, M. Z. Petrova, I. P. Zinin]

[Abstract] This article discusses improving transmission quality on analog and digital satellite links currently employing the "Kareliya-SM" baseband equipment (satellite multichannel equipment) by employing block pulse code modulation. The "Kareliya-SM" equipment is

designed for individual conversion of eight voice grade frequency channels between 300 and 3400 Hz into digital form with these signals then clustered into a digital stream at a transmission speed of 500 kbits/sec. The block pulse code modulation method provides improved noise immunity from line digital errors. The "Kareliya-SM" equipment operates with multistation access equipment. In the block pulse-code modulation method the input digital signal of each voice grade frequency channel obtained by coding signal samples by a uniform  $n$ -bit pulse modulation code is decomposed into blocks, each containing  $m$  code combinations. The code combination corresponding to the modulo-maximum sample in the given block is selected by analysis of each block. The speech transmission quality on a long-distance test channel with the "Kareliya-SM" was close to the transmission quality levels on cable transmission lines. The "Kareliya-SM" equipment also provided excellent noise immunity in tests and a high speech transmission quality with error probabilities from  $10^5$  to  $10^3$ .

#### **Investigation of a Digital Synchronization System for a Satellite Radio Link**

907K0102d Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 13-17

[Article by V. V. Shakhgildyan]

[Abstract] This article describes a satellite radio link synchronization system which performs synchronous detection of each retransmitted signal. This process requires maintenance of synchronism of the reference signals of the repeater demodulators and the earth station signals arriving at the repeater in the information transmission mode. The system employs a synchronization technique based on a phase locked loop to a single reference signal of the repeater reference oscillator. The design analyzed in the present study is for the simplest such synchronization system: one that employs no filters in the control circuit. The designs are analyzed by means of a mathematical model to identify such factors as the local noise immunity, the system noise immunity, transient processes in the system, filtering properties, etc. The derived relations can be used to calculate the primary performance characteristics of a digital synchronization system used on a satellite radio link where the repeaters perform signal processing functions.

#### **A Data Transmission Network Based on Analog Office Automatic Telephone Exchanges**

907K0102e Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 22-24

[Article by T. I. Guan, V. P. Zhavoronkov, V. A. Ualentov]

[Abstract] This article discusses a data transmission network design based on an office data transmission network employing analog office automatic telephone exchanges. The office data transmission network is

designed as a remote processing network providing user sharing of computer resources to a large number of remote subscribers. The system is intended to improve labor productivity and quality for scientific research and design, to establish reliability and comprehensiveness of the results and to improve the utility of available computing power. The use of digital office automatic telephone exchanges permit simultaneous speech and data transmission in a single digital stream, thus eliminating the use of modems and permitting higher-speed data transmission (up to  $n$  times 64 kbits/sec).

### Distribution of Signal Delay in Digital Switching Elements

907K0102f Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 32-34

[Article by G. P. Basharin, V. A. Naumov]

[Abstract] Expressions have been derived for calculating signal delay in digital switching elements employed in the digital switching bay of the System 12 digital switching system. The digital switching elements in this case are specialized space-time switching large-scale integrated circuits. The signal delay in such elements must be determined in order to establish an optimum calling algorithm. The study derives both exact and approximate formulae to determine signal delays within the integrated circuit switching elements based on the known incoming traffic level to digital switching elements on different switching stages.

### Analysis of the Spectral Noise Characteristics of a Laser-Fiber System

907K0102g Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 40-44

[Article by P. A. Mishnaevskiy, P. P. Ovvyann]

[Abstract] Original theoretical studies of the noise spectrum of laser radiation on both monomode and multimode long-distance optical fibers have made it possible to obtain expressions for calculating spectral noise performance under a variety of operating conditions. Tests conducted on monomode and multimode optical fibers and cables in lengths from 1 to 600 m in length using an ILPN-205A monomode single-frequency laser demonstrated that the noise maxima over minimum is 5-15 dB. For example, for an optical cable 563 m in length this level amounts to 10 dB at 40 MHz. The study further reveals that the noise spectrum has a periodic nature with periodicity determined by fiber length. The experimental results are in good agreement with the theoretical analysis based on the derived equations. The results obtained in this study can be used in the design of fiber-optic communications links.

### The Features of Transfer Conductance and Impedance Measurements for Cylindrical Screens

907K0102h Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 50-53

[Article by V. K. Lipskiy, I. Ch. Ronchevich]

[Abstract] A number of equations have been derived to calculate the transfer conductance and impedance in cylindrical screens used in communications technology for the case where cables are exposed to both magnetic and electrical fields in order to determine the limits of applicability of specific measurement techniques and obtain appropriate recommendations for utilizing a specific method. Several inequalities are derived in the analysis of conditions for both individual and combined measurements of transfer conductance and impedance on cables. In the majority of circuits analyzed the voltage level will be determined by both the transfer conductance and the transfer impedance. Specific measurement schemes are recommended for measuring transfer conductance and transfer impedance for specific cable lengths and applications.

### "INKOMS" Communications Equipment on Exhibit in Moscow

907K0102i Moscow ELEKTROSVYAZ in Russian  
No 12, Dec 89 pp 56-57]

[Article by I. V. Kovaleva]

[Abstract] "INKOMS", the largest state manufacturing concern producing computer equipment and hardware in the People's Republic of Bulgaria, displayed communications equipment at the Anniversary National Exhibition entitled "Bulgaria Today and Tomorrow." "INKOMS" consists of 35 factories and industrial concerns, 6 scientific institutes, and 6 design bureaus. The equipment on display included: terminal digital transmission system equipment employing trunk lines between the IKM-30 municipal automatic telephone exchanges. This equipment fully satisfies the Series G CCITT recommendations; the D-8 office mini-automatic telephone exchange designed for generating 7 subscriber lines and a single long-distance trunk from a municipal automatic telephone exchange. The automatic telephone exchange is controlled by a special microprocessor; "INFOSTAR" multifunction switched logic digital network. A 500-number office automatic telephone exchange is used as the switchboard; the TsRRA-10 ten-channel digital radio relay system. This system operates at fixed frequencies between 390 and 470 MHz; an E-100 electronic automatic telephone exchange and an PDS-E dispatcher communications control panel with an embedded microprocessor; this control panel is used to set up communications with 16 subscribers or two municipal automatic telephone exchanges.



### **Remote Control and Monitoring of a Telegraph Network**

907K0123a Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 24-26

[Article by R. D. Abramov]

[Abstract] A remote control and monitoring unit for use on terminal telegraph equipment permits total automation of measurement and monitoring operations of the terminal equipment and the communications channels on a switched telegraph network for maintenance and diagnostic purposes. The device employs a single-board microcontroller with a program package and is connected to the subscriber panel of a subscriber telegraph-intermediate exchange-data transmission exchange within the terminal bay. The unit is used to measure individual start-stop distortions, the degree of distortions, and the telegraph transmission rate and to monitor the correction capability of the receiver as well as the autoreponse availability and format. The unit operates in two primary modes: a comprehensive diagnostic monitoring mode which is used to monitor the primary performance characteristics of the terminal unit and a parameter measurement mode. The specific mode is selected by the user by transmitting special commands whose list is provided in the article.

### **An Elevated Throughput Capacity Message Switching Electronic Telegraph Concentrator**

907K0123b Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 30-31

[Article by A. A. Kachan, M. A. Sosorev]

[Abstract] This article discusses the design and introduction of the first message switching node based on an electronic telegraph concentrator. The message switching electronic telegraph concentrator is designed for use on the general purpose telegraph network. The hardware and software capabilities of the concentrator supports up to 128 telegraph communications channels and a throughput capacity of up to a single telegram per second, which satisfies the demands of most regions of the country. The specific configuration recommended for use is a message switching node that includes two message electronic telegraph concentrators. A maximum of 256 channels can be connected to a twin concentrator unit. According to preliminary estimates up to 16 channels can be used to interconnect the two concentrators. The twin message switching electronic telegraph concentrator is best employed at telegraph communications nodes where a throughput capacity of up to 1.6 telegrams per second into a total capacity of 240 signals is required. Under such conditions the twin message switching electronic telegraph concentrator unit will be efficient on all regional nodes with the exception of nodes where message switching centers are best utilized.

### **Electronic Control for a Postal Package Bay**

907K0123c Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 34-37

[Article by V. N. Dolenko]

[Abstract] A mechanized, electronically controlled postal package bay presently in use in six communications facilities in Dnepropetrovsk provides mechanization of both handling and storage of packages. The package bay consists of a control panel, weights, transporters, roller tables, a control panel, a bunker, an observation window, a cutoff device and photocells. The equipment configuration in the bay is shown together with a block diagram of the electronic control unit. The electromagnets attached to the support plates form a 16 by 16 equals 256 matrix which establishes the capacity of the bay. The electromagnets and transporters are controlled by means of relays and switches on the control panel. The photocells are mounted in front of the weights and in the upper point in the bay allowing for the inertia of the mechanisms. The photocell consists of an AL107B infrared LED and an FT-2K phototransistor with simple 15 mm focusing lenses. The study also provides schematic diagrams of the control panel and associated components as well as pin assignments for the integrated circuits.

### **Modernization and Conversion of the Vyaz-M2-OP Transmitter**

907K0123d Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 39-45

[Article by G. I. Fridman]

[Abstract] This article is devoted to the modernization and conversion of the Vyaz-M2-OP transmitter to bring the performance and specifications of the transmitter up to modern levels. Previous modifications to the transmitter have made it possible to use the unit for AM radio broadcasting applications. Description of specific changes in transmitter circuitry to improve sound quality is accompanied by detailed schematics of the audio amplifier stage and the bias voltage controls and by diagrams of required changes in the lower and upper equipment bays. In addition the article specifies proper voltage levels, wiring changes, and proper output levels, as well as appropriate tune-up and testing procedures.

### **Electrical Actions on the Static Thyristor Compensator Equipment at the Moldavian Metallurgical Factory**

907K0002a Moscow ELEKTROTEKHNIKA in Russian  
No 8, Aug 89, pp. 15-19

[Article by O. P. Nechaev, I. P. Taratuta, V. S. Chuprikov]

[Abstract] The STK-160/138-35 static thyristor compensator is used to provide reactive load power compensation and voltage stabilization on the furnace transformers. The compensator is included in the 160 MV.A thyristor-reactor

group and includes a set of 8 138 MV.A filter compensation filter networks tuned to the second, third, fourth, fifth, seventh, and eleventh harmonics. Tests were carried out on filter-compensation networks for various combinations of the networks and different furnace operating conditions at the Moldavian Metallurgical Factory in order to determine the correlation between the calculated and actual electrical actions on the equipment. Tables are given to illustrate the maximum filter compensation network current when the networks are activated and the potential at the x phase point of the filter compensation networks between the reactor and the capacitor bank. The data from this analysis suggest that the currents flowing when filter compensation network 4 is activated lie below the permitted values and exceed such values in filter compensation 3 by 90 percent and filter compensation 2 by 85 percent. The article also provides detailed tables of the same specifications for the various furnace operating conditions and filter compensation network configurations.

#### **Electromagnetic Compatibility in Electrical Power Systems for Industrial Facilities**

907K0002B Moscow ELEKTROTEKHNIKA in Russian  
No 8, Aug 89 pp 19-22

[Article by V. V. Shevchenko, I. G. Buree]

[Abstract] This article discusses the current concepts defining electromagnetic compatibility in electrical power systems supporting industrial facilities in effect in current GOST regulations. In this context electromagnetic compatibility of power systems refers to the effect of poor electricity quality, excessive loading or demand and variable current levels at certain facilities on the operation of other facilities using the same electrical power systems. The study determines that the most significant cause of disruption in electromagnetic compatibility is voltage deviations; such deviations can largely be attributed to temporary reductions in the line voltage levels (110, 220, 330, and 500 kV) due to electricity shortages, insufficient throughput capacity of several segments of the power supply system, underutilization of power transformer voltage regulators, a low power factor of semiconductor converters, etc. The study concludes that extensive research and operating experience have indicated that even today in designing electrical power systems for industrial facilities it is necessary to isolate such power users as computer hardware, lighting, pulsed equipment, etc. in separate networks at industrial facilities.

#### **Electromagnetic Compatibility Enhancement of Thyristor Converters of Comparable Power**

907K0002C Moscow ELEKTROTEKHNIKA in Russian  
No 8, Aug 89 pp 22-26

[Article by V. A. Barskiy]

[Abstract] The problem of maintaining electromagnetic compatibility of industrial and electrical engineering facilities in the hundred kilowatt to tens of megawatt

power range reduces to the maintenance of electromagnetic processes whereby nonlinear distortions or oscillations in the supply voltage lie within the guidelines specified by GOST 13109-87. In some cases the electromagnetic compatibility factors include the maximum or average reactive power consumption. The results from this study suggest that longitudinal upper order harmonic compensation circuits and LC filters on the low voltage side of the converter transformer provide new possibilities for maintaining electromagnetic compatibility of converters. In converters employing forced commutation of the phase currents an external commutating source can be used to maintain operation in the range of leading angles without substantial overvoltages while simultaneously maintaining the necessary supply voltage quality. In order to eliminate unacceptable overvoltages and improve the supply voltage in converters employing artificial gate switching, it is sufficient to install a small filter on the low voltage side of the conversion transformer.

#### **New Thyristor Converters**

907K0002D Moscow ELEKTROTEKHNIKA in Russian  
No 8, Aug 89 p 39

[Article by N. V. Sklyaruk, V. I. Vasilev]

[Abstract] Series manufacture of third generation 100-1600 kW (0.5- 10 kHz) TU16.435.089-85 thyristor converters has begun. The converters employ high-speed 100 amp thyristors with switching times up to 25 mcs. The thyristors are used for maintenance of optimum inductive heating conditions, for sintering special steels, ferrous metals and polymer materials and for tool hardening. The article also discusses the manufacture of the PPTT-63-220 a.c. semiconductor converters designed for outfitting lighting systems in industrial facilities and used to maintain a given setting of the effective phase voltage. The parameters of this unit are: nominal output voltage: 220 V; output current: 63-160 A; weight: 49 kg; efficiency: 99.3 percent. A brief report on the PN-00V-1000-380- 50-UKhL4 a.c. thyristor regulators designed for the IAT-0.4, IAK-10, INM-500 induction furnaces and other electrical smelting furnaces is also given.

#### **Modeling of Magnetization Reversal in the Core of Pulsed Transformers**

907K0002e Moscow ELEKTROTEKHNIKA in Russian  
No 8, Aug 89 pp 64-69

[Article by V. V. Karasev]

[Abstract] Equations have been developed for modeling the magnetization reversal process in the core of pulsed transformers using a standard mathematical model. Correction coefficients based on experimental results are presented. The experimental dynamic magnetization reversal loops indicate that the nature of the magnetization reversal process predicted by calculation deviates



substantially from the real process. Certain modifications were therefore introduced. The effect of magnetic viscosity was accounted for by a common analytical expression by introducing coefficients obtained for the various alloys based on experimental research. As a result the magnetization reversal could be expressed analytically. An experimental test of the calculation method was carried out for a number of alloys for both sinusoidal, square-wave, and highly nonsinusoidal voltages. The study revealed that the mathematical model made it possible to describe with sufficient accuracy the magnetization reversal processes under conditions of strong surface effects. The study also provides the necessary calculation parameters for three of the most commonly used alloys and indicates the durations of square wave voltage pulses whereby the strong surface effect occurs and the expressions provided in the study are valid.

UDC 535.41:[535.241.13:537.228]

**Response Formation in Coherent Optical Processor upon Processing of Multichannel Electrical Signals**

907K0241A Leningrad  
OPTIKO-MEKHANICHESKAYA  
PROMYSHLENNOST in Russian No 2, Feb 90  
pp 10-13

[Article by A. I. Plakhotnik]

[Abstract] A method is developed for representing the relationship between the spectrum in a spectrum analyzer and the input image which considers the contribution of individual image channels to space-time modulation of light in formation of the response at the output of the processor. It is concluded that in an optical processor designed to process phase-matched multichannel electrical signals a two-dimensional picture is formed in the output plane, the projection of which on the  $\omega_x$  axis corresponds to the signal spectrum in the individual channels, while the projection on the  $\omega_y$  axis consists of the autocorrelations of the signals frequency components with different phase delays. References 5, Russian.

UDC 53.087.92

**Accuracy of Measurement of Slope of Optical Radiation Phase Front**

907K0241B Leningrad  
OPTIKO-MEKHANICHESKAYA  
PROMYSHLENNOST in Russian No 2, Feb 90  
pp 13-15

[Article by V. Ye. Kirakosyants, V. A. Loginov, V. N. Timofeyev]

[Abstract] A study is made of the problem of accuracy of measurement of the local and aperture-average slope of

the phase front of an optical wave. The accuracy characteristics are compared for two versions of implementation of a sensor to measure the center of gravity of the diffraction spot of a field recorded in the focal plane of the receiving optics. In one version the photosensor is a four-part photosensitive surface, in the other it is a small-cell mosaic structure. The accuracy characteristics are found to depend strongly on the size of the receiving apertures. With small apertures the dispersion of error is proportional to the square of the aperture area. Comparative analysis of dynamic measurement errors related to the finite size of the receiving aperture indicates that the four-part sensor design has a significant advantage over the mosaic design: there is a gain in accuracy in measurement of the local phase front slope of 37 percent, while the measurement of the mean slope across the entire aperture is measured 4.74 times more accurately. References 2, Russian.

UDC 681.7.02

**Improvement in Metal Mirror Manufacturing Technology**

907K0241C Leningrad  
OPTIKO-MEKHANICHESKAYA  
PROMYSHLENNOST in Russian No 2, Feb 90  
pp 28, 36

[Article by Yu. V. Zaikin, Yu. V. Ashkerov]

[Abstract] Metallographic studies were made of the surface layer of worked copper parts following working with a hard-alloy tool, diamond turning and fine polishing, during which the metal flows into the tracks made by cutting and forms closed cavities. Although the appearance is thus produced of complete polishing, subsequent polishing or etching may result in opening of the closed cavities. The problem was eliminated by adding an additional step before polishing consisting of fine diamond tablet grinding with abrasive fraction 14/10  $\mu\text{m}$  in a polyurethane binder. This process was used to remove a layer 0.5 mm thick before polishing. Figures 2; References 3: 2 Russian, 1 Western.

UDC 535.317.7:681.785.66

**Confidence Intervals of Mean Square Wave Front Deformation and Contrast Transfer Function in Testing of Optical Systems**

907K0241D Leningrad  
OPTIKO-MEKHANICHESKAYA  
PROMYSHLENNOST in Russian No 2, Feb 90  
pp 32-36

[Article by I. P. Agurok]

[Abstract] The deformation of the wave front and contrast transfer characteristic are the main quality characteristics of the manufacture of optical systems. They are computed on the basis of distorted initial data and are consequently random quantities which must be represented by their values and their confidence intervals.

This article studies methods for investigating the confidence intervals of these quantities in the analysis of interferograms. Approximate equations are derived for statistical modeling of the distribution of the contrast transfer function. The results indicate that during visual observation of the maximum of interference bands with a dispersion of measurements of about 0.03 wave length, the confidence interval of wave front deformation is about 0.01 wave length, that of the contrast transfer characteristic approaches 0.007. References 5: 4 Russian, 1 Western.

UDC 681.7.068.4

### Working Ends of Fiber Light Guides

907K0241E Leningrad  
OPTIKO-MEKHANICHESKAYA  
PROMYSHLENNOST in Russian No 2, Feb 90  
pp 47-49

[Article by L. V. Borisyyuk, A. I. Vanyurikhin]

[Abstract] An experimental study was performed of a method of producing the desired shape of the end surface of a fiber light guide. The essence of the method is formation of the end of the light guide by means of an optical cement which is inserted and polymerized between the end of the fiber light guide and a substrate covered with a hydrophobic substance. A stand holds the optical fiber vertical and close to a horizontal polished surface coated with a thin layer of M50 hydrophobic substance. A microsyringe is then used to introduce a drop of optical cement with index of refraction equal to that of the light guide, after which the degreased end of the fiber light guide is lowered into the drop of optical cement then raised slightly, and the cement is allowed to polymerize. This yields a flat, smooth end to the light guide. The method is also suitable for producing ends of other desired shapes. Figures 3; References 3, Russian.

UDC 621.36:621.791.72

### The ELA-60/15, ELA-50/5T and ELA-60/15T Electron-Beam Instruments

907K0241F Leningrad  
OPTIKO-MEKHANICHESKAYA  
PROMYSHLENNOST in Russian No 2, Feb 90  
pp 49-53

[Article by A. P. Bdulenko, S. A. Garsyukov, I. M. Zilbershteyn, I. A. Kutsayev, N. I. Panteleyev, V. L. Fedorov, S. V. Shmakov]

[Abstract] The design of three electron-beam instruments intended for use in electron-beam welding devices is described. The ELA-60/15 features a wide range of change of accelerating voltage with various types of cathodes and an observation system with central optics coaxial with the electron beam. The ELA-50/5T and ELA-60/15T feature high reliability, achieved by simplifying the design and the use of an electronic focusing and guidance system, a welding cycle programmer and the

provision of the capacity for computer control to increase the quality of welding and the productivity of cyclical welding machines. The technical specifications of the units are presented.

### Delayed Structural Changes in Magnetic Field-Stimulated Semiconductors

907K0048A Leningrad FIZIKA TEKHNKA  
POLUPROVODNIKOV in Russian Vol 23 No 9, Sep 89  
pp 1596-1600

[Article by V. Davydov, Ye. A. Loskutova, Ye. P. Nayden]

[Abstract] This study provides detailed information on the changes occurring in the properties of a broad class of semiconductors induced by a weak magnetic field. The study analyzes Si, Ge, InSb, InAs, and GaAs semiconductor single crystals. The lattice constant of the semiconductors is measured by X-ray photography of FeK $\alpha$ -radiation reflected off the (444) planes (for the InSb) and FeK $\alpha$  radiation off the (333) planes (for the InAs, GaAs, and Ge). The temperatures of the specimens were measured by means of a differential thermocouple. Pulsed magnetic fields were applied perpendicular to the semiconductor surface. A metal-oxide-semiconductor (MOS) structure was used for electrophysical measurements of long-term relaxation since changes in the surface properties of the semiconductor are easily detected in such a structure. The experimental data derived in the study provides unambiguous evidence that the magnetic field action on the semiconductors produce Fresnel lattice defects, defect clustering, and accumulation; over hundreds of seconds such clusters decay, while the Fresnel defects are annihilated. The magnetic field is also discovered to cause a simultaneous increase in the capacitance of the structures and a reduction in the photovoltage. Overall the magnetic field effects on the semiconductor result in long-term changes in the structural perfection of the lattice as well as its temperature and lattice constant and therefore alters the electrophysical properties of the fabricated semiconductor structures.

### Hot Electron Microwave Noise in GaAs at Crystal Temps of 10-100 K

907K0048B Leningrad FIZIKA TEKHNKA  
POLUPROVODNIKOV in Russian Vol 23 No 9, Sep 89  
pp 1640-1642

[Article by R. D. Aitov, A. I. Moslov, K. S. Rzhevkin]

[Abstract] In a study of changes in the noise temperature of hot electrons in deeply cooled GaAs crystals, AA703 Gunn diodes which are N<sup>+</sup>-N-N<sup>+</sup>-structures with an N region 10 mcm in length and a doping level of (1-3)  $\times 10^{15}$  cm<sup>-3</sup> were used as the specimens for microwave noise analysis. Electron heating was achieved by injecting a d.c. bias voltage. The noise temperature of the diode was measured by means of a P5-16 modulation radiometer in a 2-4 GHz range. The study focuses on plots of the noise temperature, nonlinearity of the I-V characteristic and the differential resistance of the

specimen as a function of the specimen bias voltage. A correlation was found between the noise temperature versus bias voltage relation and the nonlinearity of the I-V characteristic across the entire crystal temperature range. Frequency differentials were also discovered in the noise temperature versus initial temperature range below 20° K indicating the manifestation of the inertial properties of the heated electron gas. The electron energy relaxation time in GaAs was found to increase with diminishing crystal temperature. Electron heating was also absent at very low bias voltages, suggesting a barrier mechanism in the onset of observed nonlinearities.

**Magnetic Field-Induced Electron Transitions in Semiconductors with a Superlattice**

907K0048C *Leningrad FIZIKA TEKNIKA  
POLUPROVODNIKOV in Russian Vol 23, No. 9,  
Sep 89, pp. 1180-1185*

[Article by V. M. Polyanovskiy]

[Abstract] This article discusses the features of transport phenomena along the axis of a superlattice in such a strong magnetic field parallel to the superlattice axis that the distance between the Landau levels exceeds the

mini-bandgap. The study focuses on the magnetic field-induced metal-dielectric electron transitions in a semiconductor with a superlattice. Changes in the magnetic field are found to cause the Landau levels to periodically fill or empty, i.e., metal-dielectric-metal phase transitions occur at  $t = 0$  while metal-semiconductor-metal transitions occur when  $t$  is not equal to zero. Previous results in this area are generalized to the case of nonzero temperatures in the present study. Specific expressions are derived for the longitudinal conductivity and thermovoltage. The conductivity and thermovoltage are analyzed initially as a function of the position of the Fermi levels. A plot of the conductivity and thermovoltage as a function of the applied magnetic field is provided; the results from this study also make it possible to construct a detailed picture of the metal-semiconductor and p-semiconductor- n-semiconductor electron transitions based on the field dependences of the conductivity and thermovoltage. The metal-semiconductor electron transition is found to occur when the Fermi level intersects the boundaries of the mini-band and is manifested as a sharp drop in the conductivity and a crossover to an activation temperature dependence of the conductivity on the superlattice axis as well as a sharp increase in the longitudinal thermovoltage.

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